



**Association of State and Territorial Solid  
Waste Management Officials  
Federal Facilities Research Center  
Policy & Technology Focus Group**

**FINAL**

**Perchlorate Issues Document  
July 29, 2005**

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**Association of State and Territorial Solid Waste Management Officials  
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## **EXECUTIVE SUMMARY**

The Association of State and Territorial Solid Waste Management Officials (ASTSWMO) is a non-profit trade organization supporting the environmental agencies of the States and Territories. The Association's mission is briefly stated: "To Enhance and Promote Effective State and Territorial Waste Management Programs, and Affect National Waste Management Policies". ASTSWMO's members are the State managers of hazardous waste, solid waste, and cleanup programs, who are engaged full time in the regulatory and remediation activities of their State environmental agencies, and have hands-on familiarity with the implementation of federal and State statutes, regulations and policies governing federal facilities.

The mission of the ASTSWMO Federal Facilities Research Center Subcommittee is to serve as a clearinghouse for States and Territories on information relative to federal facilities and the implementation of cleanup and waste management issues at these sites. The Subcommittee also serves to promote policies that preserve and enhance States' authorities.

In April of 2004, the ASTSWMO Policy & Technology Focus Group (PTFG) began researching Perchlorate issues and the inherent challenges and impacts of perchlorate assessment and remediation on State and Territorial programs.

Currently, Perchlorate has been detected in more than 35 States/Territories and various studies and reviews are being conducted regarding the effects of Perchlorate on human health and the environment.

This document was compiled primarily to serve as a clearinghouse of information to assist State/Territorial program managers as they prepare to deal with the environmental assessment and cleanup at sites potentially or currently contaminated with Perchlorate. The PTFG is not responsible for errors or omissions in the text or for an erroneous, outdated or non-working Uniform Resource Locator (URL). This is a "living document" and will be updated as new information becomes available. Go to [www.astswmo.org](http://www.astswmo.org) to access the most updated version.

### ***PERCHLORATE QUICK FACTS***

#### **What is PERCHLORATE?**

Perchlorate ( $\text{ClO}_4^-$ ), both naturally occurring and man-made, is a "catchall" term for the solid salts of ammonium, potassium and sodium perchlorate.

#### **What is the problem with PERCHLORATE?**

Perchlorate is highly soluble, stable, and mobile. Once dissolved in water, perchlorate is difficult to remove and can persist in the environment for a very long time.

#### **How is PERCHLORATE used?**

Perchlorate was once used to treat thyroid disorders. Large-scale production of perchlorate salts began in the 1940's for military purposes, followed by its use as a solid oxidant in rockets and missiles. Currently, perchlorate is also used in the production of blasting agents, fireworks, road flares, textile bleaching agents, fertilizers, matches, ammunitions, airbags, and chrome plating, among other uses.

#### **How does exposure to PERCHLORATE affect human health?**

Perchlorate interferes with the uptake of iodide by the thyroid gland. Iodide is an essential component of thyroid hormones needed to support normal body growth and development.

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## **1.0 INTRODUCTION**

The Policy & Technology Focus Group (PTFG) of the Federal Facilities Research Center Subcommittee of the Association of State and Territorial Solid Waste Management Officials (ASTSWMO) has developed this document in the spirit of helping readers bridge the gap between policy and technology issues emerging at federal facilities sites currently or potentially contaminated with Perchlorate.

Quickly evolving technological advances in the analytical testing arena, coupled with the lack of federal and State standards, are some of the challenges posed by this unique constituent. The plethora of information that currently exists on this topic, as well as numerous work products being developed by Perchlorate workgroups nationwide, is a direct response to the Perchlorate challenge. With this in mind, ASTSWMO presents this “peer match” style document with the goal of offering regulatory agency officials with a resource directory that is supportive of internal Perchlorate policy deliberations, as well as helpful in accessing useful information when embarking in Perchlorate site investigations and remediation design.

## **2.0 THE NATIONAL PERCHLORATE DILEMMA**

Since the 1940’s, Ammonium Perchlorate - a type of salt and a component of solid rocket fuel - has been widely used due to its “stable oxidizing” properties. More specifically, the Department of Defense (DOD) notes Perchlorate’s high ignition temperature, which serves to reduce the handling risk of users and allows more controlled and predictable munitions and propellants. According to the Department of Defense, perchlorate is currently used in over 250 types of munitions as discussed in <http://www.DODperchlorateinfo.net/facts/uses-benefits/>.

Recent research efforts, however, have revealed that Perchlorate use is not exclusive to the defense industry and National Aeronautics and Space Administration (NASA). Perchlorate is also employed in the manufacturing of fireworks, certain fertilizers, paints and enamels, road flares, textile bleaching agents, specialty industrial uses, and air bag inflators, as well as serving as a component of explosives used in blasting operations, among other uses. Because Perchlorates are highly water soluble, stable, very persistent and mobile, they travel significant distances in groundwater, often exacerbating substantial release migration conditions in the environment if not adequately addressed in a timely manner.

Scientific research also indicates that Perchlorate can affect the function of the thyroid gland, which regulates the body’s metabolism. Because of such health implications, and given that federal drinking water, soil and/or groundwater cleanup standards do not exist at this time, many States have initiated their own health-based drinking water and/or site cleanup standards promulgation process.

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## **3.0 PERCHLORATE WORK GROUPS AND ASSOCIATED LINKS**

The key objective of this ASTSWMO document is to provide the reader with primary links in support of Perchlorate policy deliberations process. Links provided herein are considered to be primary resources in better understanding the science, technology, toxicology, and regulatory aspects of Perchlorate. It is not the intent of this document to offer a position on any of the Perchlorate related matters, but rather provide the reader with a roadmap toward the gathering of information that may aid their own Perchlorate policy deliberation process. The links are provided in no particular order and will be updated as new information comes to light.

- **Department of Defense (DOD) Perchlorate Work Group:**  
<http://www.DODperchlorateinfo.net/>

The Department of Defense Perchlorate Work Group was formed in 2000 to effectively coordinate DOD efforts on Perchlorate. This work group consists of scientists, engineers, and health and safety specialists from each of the services who have compiled the latest information, sponsored research, and undertaken initiatives on a variety of Perchlorate topics including: alternatives research; health effects; analytical detection methods; treatment technologies; ecological effects; pollution prevention measures; and public outreach.

Through this Work Group's website, regulators can access the Department of the Army's June 11, 2004 update of the DOD September 29, 2003, *Interim Policy on Perchlorate Sampling and Assessment*. This policy notes the Army's ability to program resources to sample and assess Perchlorate contamination if certain conditions are satisfied. These conditions include that a reasonable basis exists to suspect that a potential release of Perchlorate contamination has occurred as a result of DOD activities by any of their components, and that a complete human exposure pathway is likely to exist. Other DOD policy and guidance documents, including DOD's sampling and testing interim guidance (February 2004), the Department of the Army's Guidance for Assessing Potential Perchlorate Contamination (June 2004) and the Navy's Perchlorate Sampling Policy, can be viewed at <http://www.DODperchlorateinfo.net/efforts/policy/>.

Also in support of the DOD's Perchlorate Work Group mission, it is the PTFG's understanding that DOD is currently preparing a Southwestern United States Perchlorate study. Once completed, this report will be provided on the ASTSWMO web site.

- **The Defense Environmental Network and Informational Exchange (DENIX):**  
<https://www.denix.osd.mil/denix/Public/Library/Water/Perchlorate/perchlorate.html>

(Due to DENIX security, you will need to copy the above link to your web browser to gain access to the public section.)

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DENIX's Perchlorate site provides a wide spectrum of information for subject areas including: new information, background (e.g., EPA Perchlorate Q&A; Perchlorate committees and subgroups (i.e., Environmental Data Quality Workgroup; Interagency Perchlorate Steering Committee [IPSC]), DOD policy and guidance, correspondence with Congress and federal agencies, correspondence within DOD and States, conferences and events, Perchlorate substitutes, occurrences, ecosystem and health effects, treatment technology, analytical detection and data quality documents.

A noteworthy link within this website's menu is *Perchlorate Links*. This link provides readers with submenus directing the reader to the American Water Works Association Research Foundation, Arizona DEQ, California DHS, and Army Corps of Engineers (ACOE) sites among many others.

- **The Environmental Council of States (ECOS) / DOD Sustainability Work Group**

[http://www.ecos.org/section//contaminants\\_in\\_groundwater\\_task\\_group/](http://www.ecos.org/section//contaminants_in_groundwater_task_group/)

Organized in 2004, this Work Group (chaired by a DOD and State representative) supports three (3) distinct task groups addressing topics of nationwide interest including encroachment, institutional controls and emerging constituents, such as Perchlorate. Of interest, in connection with this document is the Emerging Contaminants in Groundwater Task Group. Unregulated and emerging chemicals (U&EC) are generally considered as those contaminants or constituents not currently subject to regulatory controls or those that are currently regulated but under consideration for more restrictive standards. Recognizing that significant public concern and Congressional interest is driving current Perchlorate policy, the ECOS / DOD Emerging Contaminants in Groundwater Task Group has been established in part to foster ongoing dialogue between the DOD, EPA and the States and to identify and address common concerns in a mutually productive and beneficial matter.

This work group will enable DOD to better understand State positions regarding emerging contaminants such as Perchlorate. More importantly, it will provide States an opportunity to work cooperatively with DOD in developing proactive strategies aimed at recognizing and accounting for challenges in order to reduce conflict, increase public confidence, and reduce human and environmental health impacts. DOD knowledge of State priorities will allow DOD to assign resources accordingly in order to implement strategic actions that are faster, greener, cheaper, and cleaner. In the spirit of proactive "crystal balling", this Work Group will foster cooperation between DOD, the EPA and States.

In 2004, the Work Group created a Strategic Plan and is currently planning an Emerging Contaminants in Groundwater Forum, scheduled for November 2-3, 2005 in San Diego, California. For more information please contact the following representatives:

DOD Lead: Ms. Shannon Cunniff, United States Department of Defense:  
[shannon.cunniff@osd.mil](mailto:shannon.cunniff@osd.mil)

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State Lead: Mr. Eric Noack, Nevada Division of Environmental Protection:  
[enoack@ndep.nv.gov](mailto:enoack@ndep.nv.gov)

- **Interstate Technology & Regulatory Council (ITRC):**  
<http://www.itrcweb.org/common/default.asp>

ITRC has formed a Perchlorate Team that is working on a Perchlorate Overview Document. Each section of this document was developed by teams lead by a State representative and comprised of representatives from government, industry, academia, consulting and DOD. This document will address topics including an introduction to the Perchlorate topic, sources, uses and occurrences, sampling and analysis, toxicity, exposure and risk, risk management and regulatory status, and remediation technologies, as well as a reference section. The Perchlorate Overview Document is due out in the summer of 2005. For more information go to:

[http://64.203.146.45/teampublic\\_Perchlorate.asp](http://64.203.146.45/teampublic_Perchlorate.asp) to check the document development and finalization status.

In support of this comprehensive document's development, the ITRC has issued a survey to the States to gather information on State standards/guidance. As of today, the PTFG understands that ITRC has received responses from 17 States. The results are to be posted on the ITRC website when the document is completed.

The ITRC Perchlorate Team leads are Ms. Sara Arav-Piper from the Nevada Division of Environmental Protection and Ms. Laurie Racca with California EPA Department of Toxic Substances Control. Ms. Arav-Piper can be reached at 702-486-2868 and [spiper@ndep.nv.gov](mailto:spiper@ndep.nv.gov).

- **EPA's Federal Facilities Restoration and Reuse Office (FFRRO):**  
[www.epa.gov/swerffrr/documents/perchlorate.htm](http://www.epa.gov/swerffrr/documents/perchlorate.htm)

EPA's FFRRO library offers a variety of current information including: key Perchlorate documents (e.g., policies and guidelines, Perchlorate occurrences, National Academy of Sciences' (NAS) review, EPA Perchlorate resources, site-specific Perchlorate information); and other federal agency resources [e.g., DOD, US ACOE, DENIX, US Department of Health and Human Services, Agency for Toxic Substances and Disease Registry (ATSDR), U.S. Food and Drug Administration (FDA) and Federal Technologies Roundtable].

In addition, this website offers two (2) key links: Additional Information Resources and State Perchlorate advisory levels. Within the State Perchlorate Advisory Levels link, advisory levels and/or other resources are provided for a number of States including Arizona, California, Maryland, Massachusetts, Nevada, New Mexico, New York, Oregon and Texas. A list of State Perchlorate advisory levels as of April 20, 2005 can be viewed at:

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[http://www.epa.gov/swerffrr/documents/perchlorate\\_links.htm](http://www.epa.gov/swerffrr/documents/perchlorate_links.htm).

A national map and list of DOD, Federal Facilities, and other sites with Perchlorate detections can be viewed at:

[http://www.epa.gov/swerffrr/documents/perchlorate\\_map/nationalmap.htm](http://www.epa.gov/swerffrr/documents/perchlorate_map/nationalmap.htm).

The EPA FFRRO Perchlorate site also contains links to detailed discussion on EPA's new official reference dose (R<sub>f</sub>D) of 0.0007 mg/kg/day of Perchlorate. EPA's Superfund cleanup program plans to issue guidance based on the new R<sub>f</sub>D in the near future. Using this reference dose, a drinking water equivalent level (DWEL – assumes 100% contribution from drinking water exposure) for a 70 kg person drinking 2 liters per day is 24.5 ug/L. However, EPA plans for a federal drinking water standard (MCL) for Perchlorate remain uncertain at this point.

The EPA Federal Facility Forum, which makes up part of the EPA Technical Support Project (TSP), has completed their Perchlorate issue paper entitled “Perchlorate Treatment Technology Update” dated May 2005, which will be loaded on the TSP webpage ([www.epa.gov/tio/tsp/issue.htm](http://www.epa.gov/tio/tsp/issue.htm)) and CLU-IN ([www.cluin.org](http://www.cluin.org)).

The paper focuses on Perchlorate occurrence, analytical methods, treatment technologies, and human health concerns. The EPA issue paper contact is John Quander and he can be reached at 703-603-7198 or [quander.john@epa.gov](mailto:quander.john@epa.gov).

- **Government Accountability Office (GAO)**  
[www.gao.gov/](http://www.gao.gov/)

The United States Government Accountability Office (formerly known as General Accounting Office) is considered to be the “government's accountability watchdog”. According to its website, the GAO “serves Congress and the public interest by keeping a close eye on virtually every federal program, activity, and function. Its highly trained evaluators examine everything from missiles to medicine, from aviation safety to food safety, from national security to social security. Their work results in the passage of legislation, improvements in government operations, and billions of dollars in financial benefits for American taxpayers. Many of GAO's recent reports and testimonies are available on the [Reports and Testimony](#) section of the GAO web site.”

In May of 2005, the GAO issued a report to the Chairman of the Subcommittee on Environment and Hazardous Materials, Committee on Energy and Commerce, House of Representatives entitled *Perchlorate: A System to Track Sampling and Cleanup Results is Needed*. As discussed in this report, the GAO took into account nationwide research and findings for a wide spectrum of perchlorate topics in order to make three key determinations and recommendations to the EPA and the DOD. To obtain a full copy of the report, interested parties should access the link as noted below:

[www.gao.gov/cgi-bin/getrpt?GAO-05-0462](http://www.gao.gov/cgi-bin/getrpt?GAO-05-0462)



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- **Interagency Perchlorate Steering Committee (IPSC):**  
<http://www.epa.gov/safewater/ccl/perchlorate/ipsc.html>

The IPSC was formed in January 1998 and now has representatives from 24 different government agencies. Its purpose is to ensure an integrated approach to addressing Perchlorate issues and to inform and involve stakeholders about developments in the technical and regulatory arenas.

As of May 2000, the following agencies formed the membership of the IPSC: United States Environmental Protection Agency; Department of Defense; Bureau of Indian Affairs; National Aeronautics and Space Administration; National Institute for Environmental Health Sciences; National Oceanic and Atmospheric Administration; National Park Service; U.S. Department of Agriculture; U.S. Food and Drug Administration; U.S. Geological Survey; Arizona Department of Environmental Quality; Arizona Department of Health Services; California Department of Health Services; New Mexico Environment Department; Nevada Division of Environmental Protection; and Texas Commission on Environmental Quality.

- **Perchlorate Interagency Working Group (IWG):**  
<http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=72117>

The Perchlorate IWG was established in 2002 to study issues regarding Perchlorate among federal agencies including, but not limited to, EPA Office of Research and Development, Department of Defense (DOD), Department of Energy (DOE), National Aeronautics and Space Administration (NASA), Food and Drug Administration (FDA), and the Office of Management and Budget (OMB).

Several members of the IWG (EPA, DOD, DOE and NASA) requested the National Academy of Sciences (NAS) to review EPA's 2002 Draft Health Assessment on Perchlorate and the current state of the science regarding the health impacts of Perchlorate.

The Perchlorate IWG is coordinating research on Perchlorate in human breast milk, other sources, and levels in the United States. This effort is focused at the Centers for Disease Control and Prevention.

- **National Academy of Sciences (NAS) Perchlorate Peer Review:**  
<http://www4.nationalacademies.org>

Chartered by Congress in 1863, the NAS is a private, non-profit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research. In accordance with their Charter, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. In connection with this mandate, the NAS reviewed EPA's 2002 Perchlorate draft health assessment and issued a press release on January 10, 2005 for their Health Implications of Perchlorate Ingestion report.

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This document can be found at:

<http://www4.nationalacademies.org/news.nsf/isbn/0309095689?OpenDocument> and contains information on how to acquire a copy of the report.

Copies of [Health Implications of Perchlorate Ingestion](#) will be available later in winter 2005 from the National Academies Press: tel. 202-334-3313 or 1-800-624-6242 or on the Internet at: <http://www.nap.edu>.

The NAS report recommends a reference dose - R<sub>f</sub>D (daily ingestion rate) - of 0.0007 milligrams per kilogram of body weight per day. An R<sub>f</sub>D is the level per unit of body weight considered safe to consume from all sources per day without adversely affecting the health of even the most sensitive human populations. This is approximately 20 times higher than the EPA draft (2002) R<sub>f</sub>D of 0.00003 milligrams per kilogram of body weight per day. On February 18, 2005, EPA established an official reference dose (R<sub>f</sub>D) of 0.0007 mg/kg/day of Perchlorate. This level is consistent with the recommended reference dose included in the National Academy of Science's January 2005 report.

The NAS release did not propose a drinking water standard. By law, drinking water standards must consider the lower body weight of infants, and when exposure can come from a variety of sources, a drinking water standard is set lower to keep overall levels down.

#### **4.0. STATE-SPECIFIC PERCHLORATE ADVISORY LEVELS AND RESOURCE INFORMATION**

- **Arizona** – health-based guidance level of 14 ug/L in water (based on child exposures).

The Arizona Department of Environmental Quality (ADEQ) created a Web page as a source of information about Perchlorate. See <http://www.azdeq.gov/function/about/perch.html>. Questions regarding Perchlorate should be directed to Mr. Jeff Stuck at (602) 771-4617 or toll free at (800) 234-5677.

- **California** - public health goal of 6 ug/L for drinking water.

The State of California established a public health goal (PHG) of 6 ug/L for Perchlorate in drinking water in March 2004. The PHG is currently under review for consistency with the NAS risk assessment and to ensure public health protection. The process of establishing an MCL, which is required to be as close as feasible to the PHG, has been initiated, and should be completed in 2005.

For information on the California Perchlorate risk assessment, contact Mr. Robert Howd at [bhowd@oehha.ca.gov](mailto:bhowd@oehha.ca.gov).

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For information on development of the California MCL, see <http://www.dhs.ca.gov/ps/ddwem/chemicals/perchl/perchlorateMCL.htm>.

<http://www.dhs.ca.gov/ps/ddwem/chemicals/perchl/perchlindex.htm>.

For information on California's Perchlorate-related waste management and pollution control activities in the Department of Toxic Substances Control please see <http://www.dtsc.ca.gov/HazardousWaste/Perchlorate/index.html>.

Additional information on the California Prioritization Protocol for sampling activities at Department of Defense facilities to evaluate potential Perchlorate impacts to drinking water is located in **Attachment 1.0**.

- **Colorado** – To date, Perchlorate has only been found at one federal facility (and several private facilities) in the State of Colorado. The groundwater plume is located on base and there are no plans for Perchlorate standard promulgation at this time. The State of Colorado contact is Mr. Clay Trumpolt at [clay.trumpolt@state.co.us](mailto:clay.trumpolt@state.co.us).
- **Illinois** – Perchlorate has been detected in groundwater at several federal facilities. The Illinois Environmental Protection Agency (EPA) is in the process of developing a proposed groundwater quality standard, pursuant to 415 ILCS 55/8 and 415 ILCS 5/28, for Perchlorate based on the recent National Academy of Science (NAS) risk assessment. The Illinois EPA is currently discussing using a 20 percent contribution factor from other environmental sources in deriving a proposed groundwater standard for Perchlorate. The Illinois EPA will be discussing this proposal with the Interagency Coordinating Committee on Groundwater and the Groundwater Advisory Council for their input before submitting a proposal to the Illinois Pollution Control Board to amend the existing groundwater standards regulation (35 Ill. Adm. Code 620). The Illinois contact is Mr. Rick Cobb at [rick.cobb@epa.state.il.us](mailto:rick.cobb@epa.state.il.us).
- **Maine** – The State of Maine Department of Environmental Protection has identified a Point of Contact for all Perchlorate related matters. Mr. Mark Hyland (MEDEP) can be contacted at [mark.hyland@maine.gov](mailto:mark.hyland@maine.gov) or for general information consult the MEDEP's website at [www.maine.gov/dep](http://www.maine.gov/dep)
- **Maryland** – advisory level of 1 ug/L in drinking water.

The State of Maryland established a recommended advisory level for a single municipal water system impacted by perchlorate of not more than 1 ug/L Perchlorate in finished water. This does not constitute a “standard” akin to an MCL. Maryland does not currently have plans to set an MCL for Perchlorate. The State of Maryland contact is Mr. John Fairbank and he can be contacted at [jfairbank@mde.state.md.us](mailto:jfairbank@mde.state.md.us)

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- **Massachusetts** –health advisory of 1 ug/L in drinking water.

In 2001, the first instance of Perchlorate contamination in the Commonwealth of Massachusetts was identified in groundwater plumes emanating from the Massachusetts Military Reservation on Cape Cod. Since then the Massachusetts Department of Environmental Protection (MADEP) has invested significant resources and effort to detect the presence and identify the sources of Perchlorate in drinking water supplies Statewide and to evaluate the health risks of Perchlorate as new information and research becomes available.

To address Perchlorate contamination in Massachusetts, MADEP convened an external Science Advisory Committee in 2003 to evaluate the relevant peer-reviewed studies on Perchlorate. MADEP also has met with Perchlorate manufacturers and contractors who use products that contain Perchlorate, as well as representatives from DOD.

Given the limited published studies on Perchlorate and its effects on sensitive populations, in February 2004 MADEP issued a drinking water health advisory of 1 ug/L for Perchlorate, consistent with the U.S. EPA's actions resulting from the January 2002 Perchlorate health assessment document. The 1 ug/L level was adopted to be protective of sensitive populations, specifically pregnant women and their fetuses, infants and individuals with thyroid conditions.

MADEP has also begun the process to establish a drinking water maximum contaminant limit (MCL) for Perchlorate and hazardous waste cleanup standards for soil and groundwater. In March 2004, MADEP promulgated regulations requiring all public water supplies to test for Perchlorate. Also, in the fall of 2004, MADEP promulgated draft revisions to the State's hazardous waste cleanup regulations that included a proposed groundwater cleanup standard of 1 ug/L in drinking water resource areas.

MADEP and its Science Advisory Committee are currently reviewing the recent National Academy of Sciences Report on Perchlorate and other information that was recently made available. MADEP anticipates proposing a drinking water standard and hazardous waste cleanup standard in 2005. A more detailed Case Study for Massachusetts is located in **Attachment 2.0**. Please refer to the following MADEP Perchlorate link:  
<http://www.mass.gov/dep/brp/dws/percinfo.htm>.

Massachusetts's point of contact is Ms. Carol Rowan-West and she can be contacted at [carol.rowan.west@state.ma.us](mailto:carol.rowan.west@state.ma.us).

- **Nevada** –advisory of 18 ug/L in drinking water.

The State of Nevada, Division of Environmental Protection, Bureau of Water Quality Planning (BWQP) is responsible for several water quality

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protection functions that include collecting and analyzing water data, developing standards for surface waters, publishing informational reports, providing water quality education and implementing programs to address surface water quality among other functions. For more information, consult <http://ndep.nv.gov/bwqp/bwqp01.htm>.

- **New Mexico** –The State of New Mexico has a screening / advisory level of 1 ug/L in drinking water.
- **New York** – The State of New York has a planning level of 5 ug/L in drinking water, with a public notification level of 18 ug/L in drinking water.
- **North Dakota** – The Point of Contact for Perchlorate in North Dakota is Mr. Robert Disney at the North Dakota Division of Waste Management. Mr. Disney may be contacted at 701-328-5166 or [rdisney@state.nd.us](mailto:rdisney@state.nd.us).
- **Oregon** – The State of Oregon does not currently have a drinking water standard for Perchlorate. However, a very informative Perchlorate link has been developed by the Oregon Department of Environmental Quality (DEQ). Information regarding Oregon DEQ’s perchlorate efforts can be accessed through <http://www.deq.state.or.us/er/perchloratesites.htm>.
- **Rhode Island** - The State of Rhode Island Department of Environmental Management has identified a Point of Contact for all Perchlorate related matters. Mr. Matthew DeStefano (RIDEM) can be contacted at 401-222-2797 ext. 7141 or at [matthew.destefano@dem.ri.gov](mailto:matthew.destefano@dem.ri.gov)
- **Texas** – The State of Texas has established a 17 ug/L drinking water protective concentration level for residential groundwater ingestion and 51-ug/L industrial/commercial groundwater cleanup level (dependent upon whether the site falls under the old or new Risk Reduction Program). These levels were updated in 2005 when EPA posted the NAS RfD on *IRIS*.

The Texas Administrative Code (30 TAC 350) gives Texas the authority under the Texas Risk Reduction Program to establish groundwater and soil cleanup standards (protective concentration level or PCL) for environmental contaminants. The Texas Commission on Environmental Quality has established standards for Perchlorate. The Texas Perchlorate PCL tables may be downloaded as Excel spreadsheets at <http://www.tceq.state.tx.us/permitting/trrp.htm#topic3>.

The rule is written such that the equations for establishing the cleanup levels and most of the exposure parameters are part of the rule, but the reference dose is not part of the rule. Thus, Texas can update reference doses without going through rulemaking, but the resulting cleanup level is still a standard. So far, Texas has not had significant problems with responsible parties and their PCLs.

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For more information readers may contact Michael Honeycutt at [mhoneycu@tceq.state.tx.us](mailto:mhoneycu@tceq.state.tx.us) or 512-239-1793.

## **5.0 ANALYTICAL METHODOLOGIES AVAILABLE AND UNDER DEVELOPMENT**

The method currently approved for use in the Unregulated Contaminant Monitoring Rule (UCMR) is Method 314.0 (“Method 314”). This method uses an ion chromatograph with a conductivity detector to identify and quantify Perchlorate. Method 314 is being used for other types of samples beyond its original scope. Use of Method 314 in samples with high dissolved solids sometimes results in both false positive and missed identifications of Perchlorate. The method’s nominal limit of detection and measurement for Perchlorate is 4 ug/L in drinking water but this can be improved with additional quality control measures. Some States like Massachusetts have modified Method 314 to address some inherent limitations. See <http://www.mass.gov/dep/brp/dws/files/perchlor.pdf>.

The matrix presented below provides a cursory review of current as well as “under development” methodologies used to detect Perchlorate in an aqueous media, as well as soil/sediments. Both the EPA’s Office of Water (OW) and the Office of Solid Waste and Emergency Response (OSWER) are developing and assessing new methods. The methods under development offer both significantly improved sensitivity and much more reliable identification of Perchlorate.

EPA’s primary Point of Contact regarding analytical matters is Mr. Mike Carter, OSWER/FFRRO. Mr. Carter may be contacted at 703-603-0046 or [carter.mike@epa.gov](mailto:carter.mike@epa.gov).

EPA’s Office of Water is responsible for developing the water methods. For more information contact Mr. David Munch at EPA’s Cincinnati, Ohio, laboratory at 513-569-7843 or [munch.dave@epa.gov](mailto:munch.dave@epa.gov).

The DOD Environmental Data Quality Workgroup is working closely with EPA Office of Solid Waste on method assessment for both EPA Method 6850 and a more generic Method 6860 developed by DOD.

For more information see <http://www.navylabs.navy.mil/Perchlorate.htm>. The DOD contact is Mr. Fred McLean, 843-764-7337 ext 22, [mcleanfs@navsea.navy.mil](mailto:mcleanfs@navsea.navy.mil).

The EPA-OSW lead is Ms. Shen-Yi Yang, 703-308-0437, [yang.shen-yi@epa.gov](mailto:yang.shen-yi@epa.gov).

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## Water Methods

Method	Description	Development Timeframe	Method Reporting Limit (MRL)*	Comments
EPA 314.0	Current ion chromatographic method with conductivity detection for the analysis of Perchlorate.	Currently being used.	MRL is 4.0 ug/L (Target Reporting Limit of 1.0 ug/L)	May be subject to false-positive detections, especially in water with high total dissolved solids (TDS) if all QC elements required in the method are not followed.
EPA 314.1	Uses ion chromatography (IC) with a conductivity detector (most common type of instrumentation available to labs for Perchlorate analysis).	Anticipated availability April 2005.	MRL is 0.5 ug/L	Improved version of 314.0 with increased sensitivity and the use of a second ion chromatographic column for more reliable identification of Perchlorate. Method 314.1 will be the cheapest/easiest method for labs using Method 314.0.
EPA 330.0 (renamed EPA 332.0)	Uses ion chromatography with both Mass Spectrometric and dual stage Mass Spectrometric detection (IC/MS and IC/MS/MS).	Peer review status (Office of Water). Anticipated availability April 2005.	MRL is 0.2 ug/L (Target Reporting Limit of 0.1 ug/L)	With proper chromatographic separation and MS/MS detection, capable of reliably detecting sub-ug/L concentrations of Perchlorate in samples with very high TDS concentrations.
EPA 331.0	Very similar to Method 332, but uses a Liquid Chromatograph (LC) coupled with Mass Spectrometric detection (LC/MS and LC/MS/MS).	Method published March 2005. See <a href="http://www.epa.gov/OGWDW/methods/met331_0.pdf">http://www.epa.gov/OGWDW/methods/met331_0.pdf</a> .	MRL approaches 0.02 ug/L	With proper chromatographic separation and MS/MS detection, capable of reliably detecting sub-ug/L concentrations of Perchlorate in samples with very high TDS concentrations.

\*Method Reporting Limit (MRL) is the lowest concentration the method is able to accurately quantify (measure). This is usually above the method detection limit.

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## Soil/Sediment Methods

Method	Description	Development Timeframe	Method Reporting Limit (MRL)*	Comments
EPA 9058	LC/MS method under development.	EPA Office of Solid Waste and Emergency Response (OSWER)/ Office of Solid Waste (OSW) expects the completion of this method by the fall of 2005.		Contact the U.S. EPA Office of Solid Waste Methods Team in Washington, DC, Phone: 703-308-8855.
EPA 6850		EPA Office of Solid Waste and Emergency Response (OSWER)/ Office of Solid Waste (OSW) expects the completion of this method by the fall of 2005.		

\*Method Reporting Limit (MRL) is the lowest concentration the method is able to accurately quantify (measure). This is usually above the method detection limit.

## **Food Analysis**

The Food and Drug Administration (FDA) has an IC/MS/MS method similar to EPA Method 332.0 that is designed for analysis of various foods. Discussion of the method can be viewed at <http://www.cfsan.fda.gov/~dms/clo4meth.html>. FDA discussion of detection of Perchlorate in milk, bottled water, and lettuce can be found at <http://www.cfsan.fda.gov/~dms/clo4qa.html>.

## **Field Screening**

The United States Army Corps of Engineers (USACE) has released a document entitled "Field Screening Method for Perchlorate in Water and Soil", by Phillip G. Thorne, dated April 2004 with document number ERDC/CRREL TR-04-8. This inexpensive colorimetric-based screening method correlates favorably with EPA Method 314.0 results



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(detection limit of 1ug/L for water and 0.3 ug/L for spiked soils). Additional information regarding this method can be viewed or downloaded at [http://www.crrel.usace.army.mil/techpub/CRREL\\_Reports/reports/TR04-8.pdf](http://www.crrel.usace.army.mil/techpub/CRREL_Reports/reports/TR04-8.pdf).

## **6.0 CONCLUSIONS**

As with any unregulated and/or emerging constituent, regulatory agencies are tasked with the need to program substantial resources in support of policy and regulations setting that are protective of human health, welfare, safety and the environment. At this point, many States are facing the challenges posed by the release of Perchlorate to the environment and subsequent impacts.

In support of ASTSWMO's mission to bridge the gap between science, technology and policy, this document is presented to provide convenient access to the latest developments in the understanding of the science and technology of Perchlorate and to present in one concise document the various efforts to address Perchlorate at the State level. It is the hope of the Policy & Technology Focus Group that the information presented in this document will stimulate more discussion and assist our State members to make more informed public health decisions regarding Perchlorate.

For more information please contact Ms. Dania Rodriguez (ASTSWMO) at [daniar@sso.org](mailto:daniar@sso.org) or at 202-624-5973.

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## 7.0 POLICY & TECHNOLOGY FOCUS GROUP CONTACT LIST

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## **8.0 CALIFORNIA PROTOCOL FOR PERCHLORATE IMPACTS TO DRINKING WATER**

### **EXECUTIVE SUMMARY FOR THE PERCHLORATE PRIORITIZATION RESULTS FOR CALIFORNIA**

#### **Background on the Protocol**

Perchlorate has been detected in many drinking water wells in California with some wells requiring complete shutdown, causing loss of precious resources. Since perchlorate is a major rocket fuel component, the State (California Environmental Protection Agency, CAL-EPA), through the Regional Water Quality Control Boards, requested that all Department of Defense (DOD) facilities investigate the presence of perchlorate and other emergent chemicals in groundwater at these facilities. After a series of meetings between the Assistant Deputy Under Secretary of Defense (for Environment, Safety and Health, ADUSD (ESOH)) and the CAL-EPA Secretary during the summer of 2003, agreement was reached to form a joint DOD/CAL-EPA Perchlorate Working group (CA PWG) to investigate the perchlorate presence at DOD facilities. As a result, representatives from the State of California's Environmental Protection Agency (CAL-EPA), Department of Toxic Substances Control (DTSC), State Water Resources Control Board (SWRCB), Regional Water Quality Control Boards (RWQCBs), and the DOD Regional Environmental Coordinator team (DOD REC) for Federal Region IX (collectively referred to as the California Perchlorate Working Group (CA PWG)) jointly produced the *Prioritization Protocol for Perchlorate Impacts to Drinking Water from Department of Defense Facilities in California (Protocol)* dated 25 August 2004. A training workshop was held in July 2004 by the CA PWG to explain the Protocol to the users.

Although DOD has monitored for Perchlorate through the Safe Drinking Water Act's (SDWA) Unregulated Contaminant Monitoring Rule (UCMR) and the Clean Water Act (CWA) and has collected data on occurrence of Perchlorate at Defense Environmental Restoration Program (DERP) sites, in many instances data gaps remain as to possible Perchlorate releases at DOD sites. Accordingly, the Protocol is intended to aid DOD and the State in prioritizing Perchlorate investigations at sites where Perchlorate-sampling activities are unplanned and unbudgeted, given limited funding and competing sampling needs. The Protocol applies to active and closed facilities, non-operational ranges, and formerly used defense sites (FUDS) where funding has not already been allocated to address Perchlorate. Active Ranges are not included in the Protocol because they are to be assessed in the forthcoming DOD's Range Assessment Program.

The Protocol was designed as an initial screening tool to identify and prioritize sites for sampling based on proximity to drinking water supply sources. A primary component of the Protocol is the Relative Priorities Table (Table 2), used to assign relative priorities to individual sites. The relative priority for a site is dependent on the distance from the site to a drinking water supply source, whether or not the drinking

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water supply has been impacted, and whether or not perchlorate was released at the site. The Protocol considers sites that are within one mile or between one and five miles from a drinking water supply source. The Relative Priorities Table assigns the highest priority to sites where Perchlorate releases have impacted drinking water sources, and the lowest priority to sites for which existing information indicates no evidence of a release. The Table uses a sliding scale to assign relative priorities based on a lettering scheme: an “a” represents the highest priority; a “b” represents the next to highest priority, etc.

## **Implementation of the Protocol**

The Protocol was disseminated to DOD facilities for implementation under a cover letter signed on 23 September 2004 by the Assistant Deputy Under Secretary of Defense (Environment, Safety and Occupational Health). It was also sent to the SWRCB, RWQCBs, and DTSC under a cover letter signed by the CAL-EPA Secretary. An Action Plan accompanied the Protocol and provided milestones for initial implementation. State agencies and their DOD counterparts were instructed to work together to jointly determine where each facility and its individual sites fall within the relative ranking system.

As input to the process, DOD facilities reviewed existing records for each site to determine the history and quantity of perchlorate used, and to evaluate the likelihood of releases to the environment. Any existing Perchlorate sampling data was also reviewed. In addition, maps populated with water well data provided by the California Department of Health Services (DHS) were reviewed to determine if the sites are located within one mile or between one and five miles from a drinking water supply source. Using this information, and through discussions between the State and DOD representatives, either a priority letter was assigned to each site, or the representatives agreed that a prioritization of the site was not necessary nor appropriate at this time. Such sites were given a “Not Applicable” or “NA” designation.<sup>1</sup>

An “NA” designation was applied to a site if it met one or more of the following conditions:

- The site is an operational range.
- Perchlorate investigations or remediation have already been performed (or are budgeted and scheduled) at the site.
- Known hydrologic conditions indicate that the facility is neither a source nor a potential source.
- Consensus has been reached between the State and DOD that the facility is neither a source nor a potential source for an impacted water supply.
- The site is greater than five miles from a drinking water supply.

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<sup>1</sup> Although future sampling may not be required under this Protocol for sites that have “Not Applicable” designation, this is not equivalent to a State Agency regulatory decision of “No Further Action.”

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- The State and DOD found that (1) there is no impact to drinking water supply within five miles and (2) there is no indication that Perchlorate has been released from the site.

## Results of the Prioritization

Multiple sites at 84 facilities and 227 FUDS were evaluated under the Protocol. Sites at 24 facilities and 14 FUDS were assigned priority letters based on the Relative Priorities Table from the Protocol. The remaining sites were designated as “Not Applicable” (NA) to the Protocol. An excel folder with separate sub-lists containing the prioritized sites and the NA sites is provided. It should be noted that some facilities have sites on both the prioritized list and the NA list. In addition, the workbook contains a legend for the priority letters, which is Table 2 from the Protocol.

Priority letters assigned to the sites that are subject to the Protocol are summarized in the table below.

### **Number of Facilities and FUDS with Sites Assigned to Each Priority Level**

Priority Letter	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
# Facilities/ FUDS with Sites Assigned to Level	0	0	6	9	1	0	1	1	7	8	3	5	2	0	7	4



Increasing Priority

The listing containing the prioritized sites is organized alphabetically by the name of the facility/FUDS where the site(s) is located. In addition, FUDS identification numbers are listed in parentheses next to the FUDS name. For each facility/FUDS, information is organized within the following columns:

	<b>Column Heading</b>	<b>Description</b>
1	Prioritization a-p from Protocol	Assigned jointly by the DOD and RWQCB representatives for each site using the information contained in Columns 5-8 and the Relative Priorities Table in the protocol
2	Number of Sites Evaluated	Under the protocol at each installation/FUDS
3	RB	RWQCB with jurisdiction of the site
4	Service	Military service/entity with jurisdiction of the site

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5	Perchlorate release area? ( <i>Yes, No, or Unknown</i> )	Determined through DOD review of records and any existing sampling data for each site, and through joint discussions between DOD and RWQCB representatives
6	DOD Facility or Site(s) < 1 mile from water supply? ( <i>Yes or No</i> )	Determined through review of maps populated with DHS data and through joint discussions between DOD and RWQCB representatives
7	DOD Facility or Site(s) >1 and <5 miles from water supply? ( <i>Yes or No</i> )	Determined through review of maps populated with DHS data and through joint discussions between DOD and RWQCB representatives
8	Drinking water supply impacted with perchlorate? ( <i>Yes, No, or Unknown</i> )	Determined through review of maps populated with DHS data and through joint discussions between DOD and RWQCB representatives
9	Comments	May include a description of potential sources at the site or other relevant explanation of circumstances

The listing containing the “NA” sites is also organized alphabetically by the name of the facilities/FUDS where the site is located. In addition, the six conditions used to designate sites as “NA” (listed at the bottom of page 2 and top of page 3) are contained as columns. For each site, the applicable conditions are marked with an “X.”

## **Next Steps**

Actions to be taken as follow-up to the prioritization are outlined in the Protocol (Sections 3 through 5). As indicated in the Protocol, State agencies and DOD will work cooperatively to define sampling requirements for each prioritized facility or FUDS. Each DOD facility will develop a sampling plan and schedule to address data gaps. Sampling plans will consider previously scheduled activities, available funding, and base closure activities, as applicable. State Agencies will provide information on sampling requirements and coordinate with the DOD facilities to accomplish the sampling. In addition, the State will ask DHS to pursue water purveyors to sample untested public drinking water sources that are within five miles of DOD sites.

## **PRIORITIZATION PROTOCOL FOR PERCHLORATE IMPACTS TO DRINKING WATER FROM DEPARTMENT OF DEFENSE FACILITIES IN CALIFORNIA**

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### **Introduction**

Perchlorate is being found at increasing frequency in drinking water in California. To better assess the threat that this chemical may pose to drinking water supplies, State agencies are evaluating potential sources of perchlorate throughout California. As part of this evaluation, State agencies are gathering information from a variety of manufacturers and users of perchlorate, including Department of Defense (DoD) installations (USMC, Air Force, Army, and Navy) and Formerly Used Defense Sites (FUDS). The Office of the Secretary of Defense has communicated the DoD commitment to work with the State of California in setting priorities for determining the source and magnitude of perchlorate problems at military facilities, communicating and understanding California's requirements related to perchlorate and assisting in marshalling assets and resources for researching effective treatment technologies. Although State agencies are interested in obtaining information pertaining to state-designated emergent chemicals (n-nitrosodimethylamine, 1,4-dioxane, 1,2,3-trichloropropane, hexavalent chromium, and polybrominated diphenyl ether), this document pertains only to gathering additional perchlorate information from DoD installations and FUDS in California.

### **Purpose and Scope**

The purpose of this document is to aid DoD Services and State Agencies in prioritizing perchlorate sampling activities. Both the State Agencies and DoD recognize that, for the most part, the cost of investigation of perchlorate releases has not been included in the environmental restoration budgets, nor have the investigation activities been programmed into the schedule of environmental activities at most DoD installations and FUDS. Where these activities were unplanned and unbudgeted, given limited funding and competing sampling needs, this document is intended to aid DoD and the State in prioritizing perchlorate investigations, assigning the highest priority to those DoD installations in California where perchlorate releases have impacted drinking water sources.

Because the most pressing concern is the protection of California's water supply, this guideline focuses its sampling and investigation efforts on drinking water impacts. This focus is not intended to discount or dismiss other potential impacts or exposure pathways that may also pose a concern.

This prioritization protocol is not intended to delay or replace perchlorate sampling and response actions where DoD Services and installations have already budgeted resources and scheduled activities. This includes sampling and response actions associated with ongoing regulatory activities being overseen and/or directed by US EPA, the State, and/or the military in its capacity as lead agent under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). For sites where resources have already been budgeted and activities scheduled that include perchlorate, the ongoing

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efforts to characterize and respond to known perchlorate contamination should continue and should not be delayed by re-assessing the installation/site using this protocol.

This guideline is only a first step in identifying potential perchlorate releases at DoD installations and FUDS. If perchlorate releases are discovered, it is the intention of both DoD and the State to more fully characterize and respond to those problems by timely integration into DoD's Munitions Response Site Prioritization Protocol [10 USC 2710(b)] and DoD's existing environmental response programs under the Defense Environmental Restoration Program (DERP), appropriate Base Realignment and Closure (BRAC) programs, Resource Conservation and Recovery Act (RCRA), and/or the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

In many instances, DoD installations and FUDS have voluntarily sampled for perchlorate at Defense Environmental Restoration Program sites, in accordance with CERCLA and the NCP, and at drinking water supply systems in accordance with the Unregulated Contaminant Monitoring Rule, as implemented by states. Much of the information collected to date has been made available to State agencies. DoD Services and their Installations will continue providing this data to the State as it becomes available.

This protocol does not apply to operational ranges. Ranges are addressed as part of a separate DoD program as referenced in the "DoD Sampling Policy" section of this document, immediately below.

## **DoD Sampling Policy**

To adequately plan and budget for future program requirements, DoD issued policy on 29 Sep 2003 (see attached), which directs DoD Components to: 1) continue to consolidate existing perchlorate occurrence data; 2) sample any previously unexamined sites where a perchlorate release is suspected because of DoD activities and where a complete human exposure pathway is likely to exist; and 3) establish and maintain databases containing perchlorate sampling data collected during the course of compliance monitoring. In carrying out this policy in California, DoD Services and their installations propose to work with State agencies in accordance with the following guidelines.

It is noteworthy to mention that Ranges are addressed in the DoD Munitions Action Plan (MAP) with a web link shown here - <https://www.denix.osd.mil/denix/DOD/Working/OEESCM/Map/map-finalnov01.doc>. Further, the DoD interim Policy on Perchlorate Sampling of 29 Sep 03 addresses Ranges as follows:

“Assessing operational ranges for the potential for off-range migration of perchlorate is consistent with the Munitions Action Plan and the Defense Planning Guidance (DPG) requirements. The DPG requires the Secretaries of the Military Departments to assess potential hazards from off-range migration of munitions constituents. This policy memorandum requires the Military Departments to include perchlorate in future range assessments”.

## **State Responsibilities**

The State environmental regulatory agencies are responsible for ensuring protection of public health and the environment, including protection of the waters of the state as well as other resources. This document is not intended to substitute or abridge the State agencies' responsibilities or authorities in fulfilling its public health and environmental protection mandates.



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## Guidelines

These guidelines outline planning, prioritization, investigation/sampling and reporting of perchlorate activities to be undertaken by the DoD Services at installations and FUDS in California in coordination with State agencies.

### **1. Planning**

In accordance with DoD Interim Sampling Policy of 29 Sep 03, the cognizant service office will screen those installations and FUDS where DoD use of perchlorate may have resulted in a release to the environment. The purpose of these planning activities is to gather information related to the following three questions to assist in the prioritization effort:

- 1) Was perchlorate used, and if so, where?
- 2) Was perchlorate released into the environment, and if so, is there information to indicate quantities?
- 3) Is there a likely complete human exposure pathway for drinking water (public and private sources)?

The following are activities to be carried out by DoD Services and the Installations and State agencies in this planning effort:

#### DoD:

- a) Review existing records to determine the history of perchlorate use and the likelihood of releases to the environment. Activities that could potentially result in or contribute to perchlorate releases are identified in Table 1. DoD Services and Installations should consider the amount of perchlorate used, or disposed, and/or the extent of perchlorate related activities at active or closed installations, non-operational ranges and FUDS.
- b) Work with State agencies to assess if a perchlorate release is likely to have occurred.
- c) Evaluate the relationship between the proximity of the potential perchlorate-release areas to the likelihood of human exposure.
- d) Coordinate all findings with State agencies.

#### State Agencies:

Use Geographical Information System (GIS) data and analytical results from drinking water source testing to:

- a) Develop maps and other resources to illustrate the proximity between perchlorate detections at a concentration of  $\geq 6$  ppb in drinking water supply wells and sources and nearby (within 1 (one) and 5 (five) miles) DoD installations or FUDS.
- b) For those drinking water supply wells where perchlorate has been detected at a concentration of  $\geq 6$  ppb and which are located within one mile or five miles of the nearest DoD installation or FUDS, determine if perchlorate has been detected more than once, using historical analytical results.
- c) Develop maps and other resources to illustrate the proximity between any other public drinking water supply wells or sources and nearby (within one mile or five miles) DoD installations or FUDS.
- d) Determine whether a non-DoD perchlorate release is within 1 or 5 miles of the impacted public water supply source.
- e) Coordinate all findings with DoD Services and Installations.

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## **2. Prioritization**

Sites identified through the planning step as potential or actual sources of perchlorate contamination and for which environmental data are not available will be prioritized for sampling in coordination with State agencies. A Relative Priorities Table (See Table 2) is provided to aid the project managers in prioritizing perchlorate sampling at installations and FUDS.

The relative priority is a function of that which is known about perchlorate in sources of drinking water, that which is known about releases of perchlorate, and the proximity of the DoD installation or FUDS where a release may have occurred to a source of drinking water. The close proximity (within one mile) of an impacted drinking water source to a known perchlorate release at a DoD installation or FUDS would warrant the highest priority for sampling.

## **3. Investigation/Sampling**

State agencies and DoD Services and Installations will work cooperatively to define sampling requirements for each installation or FUDS.

### DoD:

- a) Identify significant data gap(s) at installations and FUDS with highest priority rankings during the planning and prioritization steps. The DoD Services and Installations will develop a sampling plan and schedule to address the data gap(s). The sampling plan and schedule should consider previously scheduled environmental response activities, available funding, and base closure activities (if applicable).
- b) The sampling plan should address primarily groundwater sampling, using existing sampling locations. The plan may also consider sampling groundwater treatment system influent and/or effluent as an option for determining groundwater and surface water impacts. In situations where no sampling locations exist between a facility and an impacted well, the necessary investigation to determine if perchlorate has been released to groundwater will be decided between the agency and installation.
- c) The sampling plan should specify the use of US EPA or California approved analytical methods for the appropriate media and address analytical reporting limits and any potential interference that may affect the reporting limit.

Sampling plan and schedule development for each installation or FUDS will be coordinated with the appropriate state agencies.

### State Agencies:

- a) Provide information on sampling requirements, including reviewing elevated detection limits, potential migration pathways, and laboratory methods.
- b) Coordinate requirements with DoD Services and Installations.
- c) If State agencies desire to collect split samples, such a request will be communicated at the time of the development of the plan.
- d) Will request DHS to pursue water purveyors to sample public water supply sources that have not been tested within one mile or five miles of DoD sites.

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## **4. Reporting**

Installations and FUDS will report results of investigation/sampling to regulatory agencies concurrent with reporting required by the DoD sampling policy. Results will be submitted in a format consistent with the format required by the DoD sampling policy.

The current analytical reporting limit per the approved US EPA-method for drinking water is 4 ppb and any results below this value may be reported as < 4ppb or verification of selected samples should be done using LC/MS/MS. Values lower than 4 ppb should also be reported with qualifications of the testing method.

## **5. Response Actions**

This document is intended to address only the collection and submittal of perchlorate data in accordance with the above-described guidelines. If perchlorate releases are discovered, it is the intention of both DoD and the State to more fully characterize and respond to those problems by timely integration into DoD's Munitions Response Site Prioritization Protocol [10 USC 2710(b)] and DoD's existing environmental response programs under the Defense Environmental Restoration Program (DERP), appropriate Base Realignment and Closure (BRAC) programs, Resource Conservation and Recovery Act (RCRA), and/or the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Any activities beyond the reporting of data will be addressed separately.

### **Anti-Deficiency Act**

Any requirement for the payment, expenditure or obligation of funds by a DoD Installation with regards to work under this Protocol, shall be subject to the availability of appropriated funds and the provisions of 10 U.S.C. section 2703. No provision of this Protocol shall be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act, 31 U.S.C. section 1341. In cases where payment or obligation of funds would constitute a violation of the Anti-Deficiency Act, the schedules and dates established requiring the payment or obligation of such funds shall be appropriately adjusted.

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**TABLE 1  
DoD ACTIVITIES WITH POTENTIAL  
FOR PERCHLORATE RELEASE**

<b>Activity</b>	<b>Yes</b>	<b>Maybe</b>	<b>Comments</b>
Solid Fuel Missile & Rocket Manufacture/Maintenance	X		"Hog out" due to shelf -life limitations
Munitions Manufacture/Maintenance	X		
Munitions Training or Testing	X		
Munitions Demilitarization	X		"Hog-Out" of solid propellants
Munitions Open Burn/Open Detonation Facility	X		
JATO Bottle Maintenance		X	
Flare Disposal	X		
Ordnance Propellants Manufacture/Maintenance		X	
Pyrotechnics	X		
Dye Marker Disposal		X	by-product or an impurity
Electroplating Facility		X	by-product or an impurity
* This table does not identify all possible perchlorate activities. The list reflects major types of activities that should be considered for this initial prioritization.			

**TABLE 2  
RELATIVE PRIORITIES**

Priority	Drinking Water Supply Impact? *			Perchlorate Release Area?			Distance Between Perchlorate Release Area (or Installation or Site Boundary) and Drinking Water Supply Source *	
	Yes	Unknown	No*	Yes	Unknown	No **	Within 1 mile	> 1 mile but < 5 miles
<p><b>HIGHEST</b></p> <p>↑</p> <p>↓</p> <p><b>LOWEST</b></p>	a.	X		X			X	
	b.	X		X				X
	c.	X			X		X	
	d.	X			X			X
	e.		X		X		X	
	f.		X		X			X
	g.			X	X		X	
	h.			X	X			X
	i.		X			X	X	
	j.		X			X		X
	k.			X		X	X	
	l.			X		X		X
	m.†	X					X	X
	n.†	X					X	X
o.†		X				X	X	
p.†		X				X	X	

\* Drinking water supply refers to either the drinking water well or surface water intake.

\* Available data shows that testing was performed but that perchlorate was not detected at detectable levels.

\*\* This category includes sites where perchlorate has been handled but information available shows no evidence of a release.

† No action required at this time. Although under this protocol sampling may not be required, this is not equivalent to a State agency regulatory decision of "No Further Action."

## PRIORITIZATION PROTOCOL FOR PERCHLORATE AT DEPARTMENT OF DEFENSE FACILITIES IN CALIFORNIA

### PLANNING

<p><b>DoD</b></p> <ul style="list-style-type: none"><li>• Review records for onsite perchlorate use, disposal, processing</li><li>• Determine DoD installations and FUDS where use of perchlorate may have resulted in a release to the environment.</li><li>• Coordinate with State agencies on the assessment of a potential perchlorate release and the likelihood of a completed pathway to human receptors</li></ul>	<p><b>State Agencies</b></p> <ul style="list-style-type: none"><li>• Evaluate the proximity between water supply sources and DoD installations or FUDS</li><li>• Evaluate historical analytical results of water supply sources to determine if perchlorate has been detected, and if so, more than once.</li><li>• Coordinate with DoD installations in the planning process.</li></ul>
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### PRIORITIZATION

<p><b>DoD</b></p> <ul style="list-style-type: none"><li>• Identify and prioritize potential and actual perchlorate contaminated sites for sampling, according to the state-provided ranking.</li><li>• Coordinate with State agencies on prioritizing sites.</li></ul>	<p><b>State Agencies</b></p> <ul style="list-style-type: none"><li>• Provide ranking system to aid project managers in prioritizing perchlorate sampling at installations.</li><li>• Coordinate with DoD Services and Installations in submitting a sampling plan or reporting sampling data based on the prioritization rank.</li></ul>
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### INVESTIGATION /SAMPLING

<p><b>DoD</b></p> <ul style="list-style-type: none"><li>• Develop sampling plan and schedule for high priority facilities with data gaps. Treatment system influent and effluent can be used as one way to determine impacts to groundwater.</li><li>• Potential perchlorate release(s) to an impacted drinking water source will be considered.</li></ul>	<p><b>State Agencies</b></p> <ul style="list-style-type: none"><li>• Provides advice on sampling requirements, including reviewing elevated detection limits, potential migration pathways, split samples, and laboratory methods.</li><li>• Coordinates requirements with DoD Services and Installations</li></ul>
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## **9.0 PERCHLORATE ISSUES IN MASSACHUSETTS: A CASE STUDY**

**The Massachusetts experience with perchlorate contamination in groundwater illustrates the need for state regulators to evaluate data with an open mind and the importance of having resources available to pursue independent investigations.**

In the late 1990's as the magnitude of perchlorate contamination in California water supplies became more widely known, Massachusetts regulators became more concerned about the potential for widespread contamination across the Commonwealth. Massachusetts Department of Environmental Protection's (DEP) focus was initially on former and current military installations in the state. In August 2000, Perchlorate was reported at the Massachusetts Military Reservation (MMR) in Bourne, Massachusetts on Cape Cod. Routine sampling of perchlorate commenced in the year 2001. In January of 2002, Perchlorate was detected in several Town of Bourne municipal water supply wells at low ( $< 1 \mu\text{g/L}$ ) levels, in private wells in the area ( $1- 2 \mu\text{g/L}$ ), and in various groundwater plumes at Camp Edwards (northern portion of the MMR) at concentrations up to  $500 \mu\text{g/L}$ .

In response to the perchlorate detections, the Bourne Water District (BWD) voluntarily and temporarily shut three affected wells. Since there were no (and still are no) established drinking water standards for perchlorate, in March 2002, the BWD formally requested guidance from MA DEP on perchlorate in drinking water. In order to assist the BWD, DEP toxicologists and risk assessors reviewed available information on the toxicity of perchlorate, including the draft EPA health assessment for perchlorate (U.S.EPA, 2002a), which contained a draft reference dose and an associated drinking water limit of 1 ppb for perchlorate. This report, as well as other information reviewed, indicated that risks to sensitive subgroups, including pregnant women, children and individuals suffering from hypothyroidism, could not be ruled out at perchlorate drinking water concentrations above 1 ppb. As these risks included the potential for serious adverse outcomes, including permanent neurological effects from *in utero* and postnatal exposures, MA DEP provided the BWD with interim advice recommending that these sensitive subgroups be informed when perchlorate concentrations exceed 1 ppb and be advised to avoid consuming the water.

Recognizing the potential for perchlorate to be discovered in other water supplies, in June 2003, DEP convened an external Science Advisory Committee to evaluate the relevant peer-reviewed studies on perchlorate. The Department also met with perchlorate manufacturers and contractors who use products that contain perchlorate, as well as representatives from the Department of Defense. Given the limited published studies on perchlorate and its effects on sensitive populations, and consistent with our standard practice, in February 2004 DEP issued a statewide drinking water health advisory of 1 ppb for perchlorate. The 1 ppb advisory level was adopted to be protective of sensitive subpopulations, specifically pregnant women and their fetuses, infants and individuals with thyroid conditions.

Concurrently, DEP initiated the processes to promulgate standards for perchlorate under both the state Drinking Water Program (Massachusetts Maximum Contaminant



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Levels, or “MMCLs”) and the Waste Site Cleanup Program (Method 1 Standards for Soil and Groundwater, as well as Reportable Concentrations and Upper Concentration Limits).

In the spring of 2004, DEP began its regulatory revisions process to the Massachusetts Contingency Plan (310 CMR 40.0000) that included a comprehensive reevaluation of existing cleanup standards. Standards for perchlorate were developed for the first time based on the 0.00003 mg/kg/day Reference Dose established by DEP’s Office of Research and Standards through its external perchlorate advisory group.

The draft standards were issued in September 2004 with an extended public comment period through December 10, 2004. The draft cleanup standard for category GW-1 groundwater was 1 µg/L. Four Public Hearings were held across the state in November, including one in Bourne. DEP has not promulgated final standards, as the agency is currently reviewing the National Academy of Sciences Report on perchlorate that was released in January 2005. Refer to <http://www.mass.gov/dep/bwsc/regs.htm#dregs>

Also, in March 2004, the DEP issued emergency regulations under its Drinking Water program (310 CMR 22) that require monitoring for perchlorate in public water supplies beginning in March of 2004. This “Occurrence Monitoring” would establish a database on the location and level of perchlorate contamination in drinking water supplies that could then be used to support the development of a Massachusetts MCL. The monitoring effort resulted in the identification of nine (9) water supply systems with perchlorate detections ranging between >1 to 1300 ppb.

The Occurrence Monitoring directed by MADEP soon dispelled three misconceptions concerning perchlorate:

1. Perchlorate cannot be reliably measured below 4 µg/L. **False.** After three rounds of laboratory Proficiency Tests and the evaluation of QA/QC data from hundreds of samples, it is now well established that a minimum reporting level (MRL) for Perchlorate of 1.0 µg/L is routinely achieved using a modified USEPA Method 314.0. <http://www.mass.gov/dep/brp/dws/percinfo.htm#lab>
2. Perchlorate is pervasive in the water supplies. **False.** Only a handful of systems – 9 of the 591 tested – reported Perchlorate concentrations greater than 1 µg/L.
3. Perchlorate is almost exclusively associated with military-related activities. **False.** None of the public water supply systems with Perchlorate concentrations greater than 1 µg/L were associated with Department of Defense activities.

As noted, in January 2005, the National Academy of Sciences issued a report on perchlorate recommending a reference dose - R<sub>f</sub>D (daily ingestion rate) of 0.0007 milligrams per kilogram of body weight per day. DEP reconvened has reconvened its Science Advisory Panel and is currently evaluating the report and other data that was recently made available. Massachusetts will continue to evaluate all available information in the process of setting drinking water and hazardous waste cleanup

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standards for perchlorate. DEP anticipates proposing a drinking water MCL and hazardous waste cleanup levels in Spring 2005.

Since publishing the draft MCP standards and beginning the Occurrence Monitoring, MADEP has been pursuing several perchlorate-related activities:

- **Protection of Private Wells.** Many of the perchlorate-contaminated public water supply systems identified through the occurrence monitoring program are located near private wells that were not required to be tested. MADEP tested private wells in concentric circles to identify those that were affected by the contamination. Concentrations in the some private wells were as high as 1,200 µg/L.
- **Source Identification.** In addition to military sources at the Massachusetts Military Reservation, DEP has encountered a number of other sources of perchlorate contamination:
  - The range of possible significant perchlorate sources was broadened in 2003, when the Department of the Army (DoA) produced a technical report attributing some of the perchlorate contribution in one plume at Camp Edwards to the annual fireworks display put on by a nearby Town. In 2004 DEP tested this hypothesis by both indirect (a water supply occurrence monitoring process) and direct (fireworks site sampling and modeling) measures. Fireworks are also the suspected source at several of the public water supplies that have been impacted by perchlorate.
  - The putative source of perchlorate at several of the sites appears to be the residue from blasting activities. In fact, perchlorate contamination was detected in three public water supply wells where nearby blasting operations were executed. Although the environmental impacts from the use of perchlorate-containing blasting agents and explosives have not been fully defined, MADEP believes it is prudent for contractors to take reasonable steps to minimize potential problems in this regard. Guidance in the form of a memorandum entitled *Potential Environmental Contamination From the Use of Perchlorate-Containing Explosives Products* can be found at <http://www.mass.gov/dep/bwsc/files/blasting.htm>
  - A significant, yet unexpected, source of perchlorate contamination was discovered to be the use of perchloric acid in an industrial process. A public water supply that draws from a major river, serving a community of 25,000 people, had measured perchlorate concentrations greater than the DEP Advisory Level of 1 µg/L on several occasions during low flow summer months. Perchlorate, that had not typically been monitored in wastewater discharges, was discovered in a discharge from a publicly owned wastewater treatment works that was located a couple of miles upstream of the surface water public water supply. After tracing the perchlorate to its source using LC/MS/MS analytical methodology and targeting industrial dischargers, it was determined that an industrial process used to “bleach” medical and surgical materials was discharging

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concentrated (70%) perchloric acid in its rinsewaters to a 3 mgd POTW. There was sufficient perchlorate in the discharge, without any significant decomposition, to contaminate over a billion gallons per day of river water to above 1 µg/L. The significance of this finding would indicate the possible need to investigate further the locations that potentially use perchloric acid in industrial quantities and to monitor the final fate of the Perchlorate.

- **Fate and Transport Research.** In order to evaluate the likelihood that annual fireworks displays could result in measurable perchlorate contamination in the groundwater, MADEP arranged to conduct research on state property at a location where fireworks displays are conducted twice a year. The Department has installed monitoring wells, established baseline (pre-display) concentrations and conducted four rounds of post-fireworks monitoring. Preliminary results of this research are expected in the spring of 2005.
- **Treatment and Prevention Technologies.** A significant level of MADEP resources have been devoted toward the extensive researching, as well as pilot testing of technologies that aim to treat and prevent the release of perchlorate in the environment. MADEP is aware of a number of technologies including **biological** processes such as *ex situ* bioremediation (e.g., anaerobic or anoxic including fluidized bed/bioreactors), *in situ* bioremediation, phytoremediation, soil bioremediation; **physical** processes (e.g., conventional/selective ion exchange, conventional and tailored GAC, reverse osmosis); **chemical** processes (e.g., concentrated brine treatment); **thermal** processes; **emerging** processes (e.g., *in situ* biobarriers). MADEP's experience at the Massachusetts Military Reservation (MMR) includes the successful use of field scale pilot studies with tailored GAC and two (2) types of ion exchange resins. Said pilot study successfully treated average perchlorate concentrations of 3 ppb down to a method detection limit of 0.35 ppb. All piloted media were successful at treating low concentrations of perchlorate to non-detect levels without the need for changeout (60,000 bed volumes) for at least six (6) months at 10 gpm (low flow) and with no negative impact on groundwater chemistry. Similar technologies have also been employed at municipal water supplies with the goal of ensuring that water distributed to consumers is safe to drink.

A compendium of perchlorate information can be located at <http://www.mass.gov/dep/brp/dws/percinfo.htm>. This information includes:

- **General Information** (Perchlorate Q&A, Letter to Blasting Contractors and Interested Parties, Letter to Public Water Suppliers Regarding Perchlorate Monitoring);
- **Health Effects** (Health Effects of Perchlorate, Perchlorate Toxicological Profile and Health Assessment, Final Draft, Perchlorate Toxicological Profile and Health Assessment – Poster Presentation);
- **Regulation and Guidance** (Proposed Notification and Cleanup Standards, Emergency Perchlorate Monitoring Regulation, Summary of April 20, 2004 Perchlorate Regulations Hearing Comments, Perchlorate Monitoring and

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Response SOP, Modifications to the Perchlorate Monitoring and Response SOP, Surface Water Detections, Instruction and Template for the Public Water System for Perchlorate, Public Notice)

- **Laboratory Testing** (Perchlorate Laboratories Approved by MADEP, Letter to Certified Labs Regarding Perchlorate Testing, Summary Report of the First Low-Level Perchlorate Proficiency Test Study Conducted by the Massachusetts Department of Environmental Protection)
- **Monitoring Data** (Perchlorate Monitoring Results – Confirmed Above 1.0 ppb, Public Water Supplier Information on Perchlorate Testing of Bottled Water, Consumer Information on Perchlorate Testing for Bottled Water)